Model for Analysis of Energy Demand (MAED)

Hands-on 6: Base Year Reconstruction Part II

Learning outcomes

By the end of this exercise you will be able to:

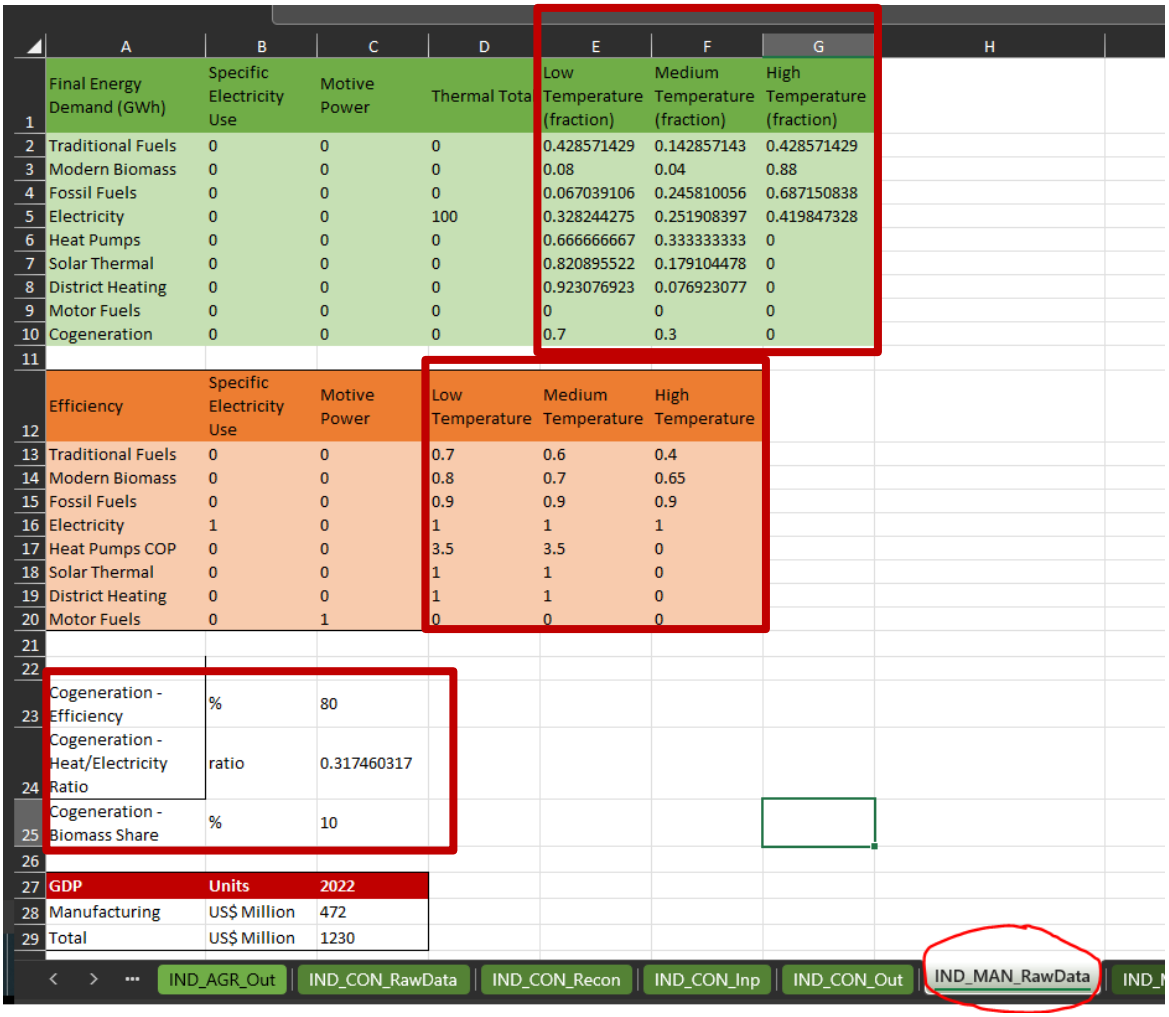
1) Point at the specific requirements of the Manufacturing Sector
2) Point at the specific requirement of the Household Sector.

Activity 1: Specific requirements of the Manufacturing Sector

As previously explained, the Manufacturing sector which is part of the Industry sector has a similar structure to the Agriculture, Mining and Construction (AMC) which we have seen in the previous Hands-on. There are a couple of additions: a) the demands for thermal uses are split into High Temperature, Medium Temperature and Low Temperature and b) we need to collect additional cogeneration factors. In Zenodo, you can find an updated Excel template here with a super simple fictitious example for the reconstruction of the Manufacturing sector.

https://doi.org/10.5281/zenodo.7750263

As previously done, now go to **IND_MAN_RawData Sheet.** You can see that the **Final Energy Demands** have been divided into three temperatures level as well as the **Efficiencies**. Then, the cogeneration data have been collected as well as the **Driving Parameter which is the GDP** for Manufacturing.



	A	B	C	D	E	F	G	H
1	Final Energy Demand (GWh)	Specific Electricity Use	Motive Power	Thermal Tota	Low Temperature (fraction)	Medium Temperature (fraction)	High Temperature (fraction)	
2	Traditional Fuels	0	0	0	0.428571429	0.142857143	0.428571429	
3	Modern Biomass	0	0	0	0.08	0.04	0.88	
4	Fossil Fuels	0	0	0	0.067039106	0.245810056	0.687150838	
5	Electricity	0	0	100	0.328244275	0.251908397	0.419847328	
6	Heat Pumps	0	0	0	0.666666667	0.333333333	0	
7	Solar Thermal	0	0	0	0.820895522	0.179104478	0	
8	District Heating	0	0	0	0.923076923	0.076923077	0	
9	Motor Fuels	0	0	0	0	0	0	
10	Cogeneration	0	0	0	0.7	0.3	0	
11								
12	Efficiency	Specific Electricity Use	Motive Power	Low Temperature	Medium Temperature	High Temperature		
13	Traditional Fuels	0	0	0.7	0.6	0.4		
14	Modern Biomass	0	0	0.8	0.7	0.65		
15	Fossil Fuels	0	0	0.9	0.9	0.9		
16	Electricity	1	0	1	1	1		
17	Heat Pumps COP	0	0	3.5	3.5	0		
18	Solar Thermal	0	0	1	1	0		
19	District Heating	0	0	1	1	0		
20	Motor Fuels	0	1	0	0	0		
21								
22								
23	Cogeneration - Efficiency	%	80					
24	Cogeneration - Heat/Electricity Ratio	ratio	0.317460317					
25	Cogeneration - Biomass Share	%	10					
26								
27	GDP	Units	2022					
28	Manufacturing	US$ Million	472					
29	Total	US$ Million	1230					

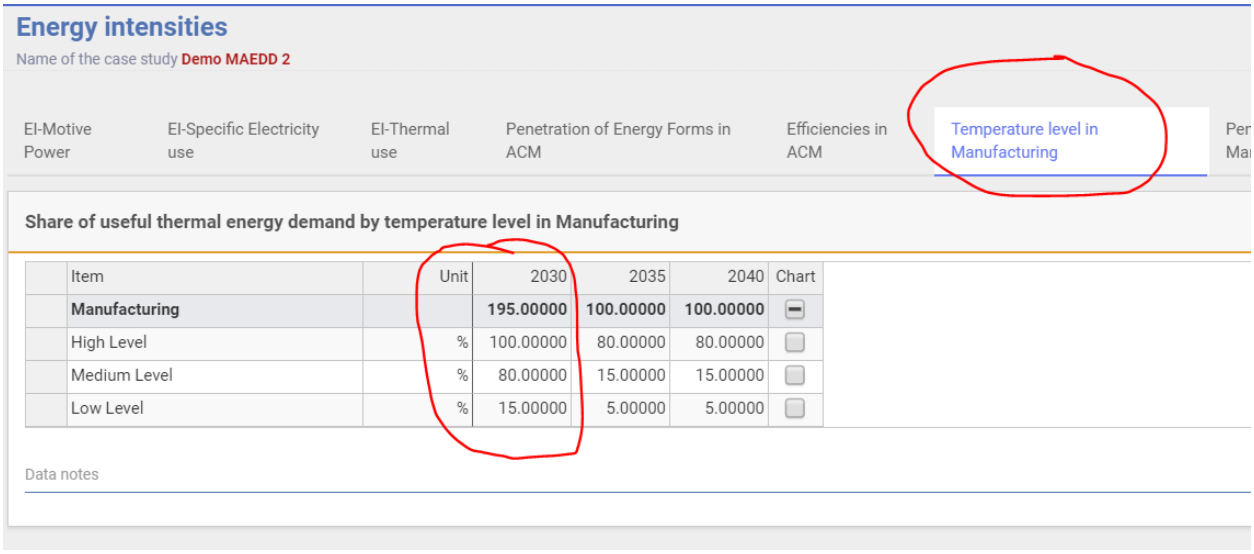
IND_AGR_Out | IND_CON_RawData | IND_CON_Recon | IND_CON_Inp | IND_CON_Out | IND_MAN_RawData | IND_

Then move to **IND_MAN_Reco Sheet** to repeat the calculation for obtaining the Useful Energy Demand and the Penetration of the Energy Forms.

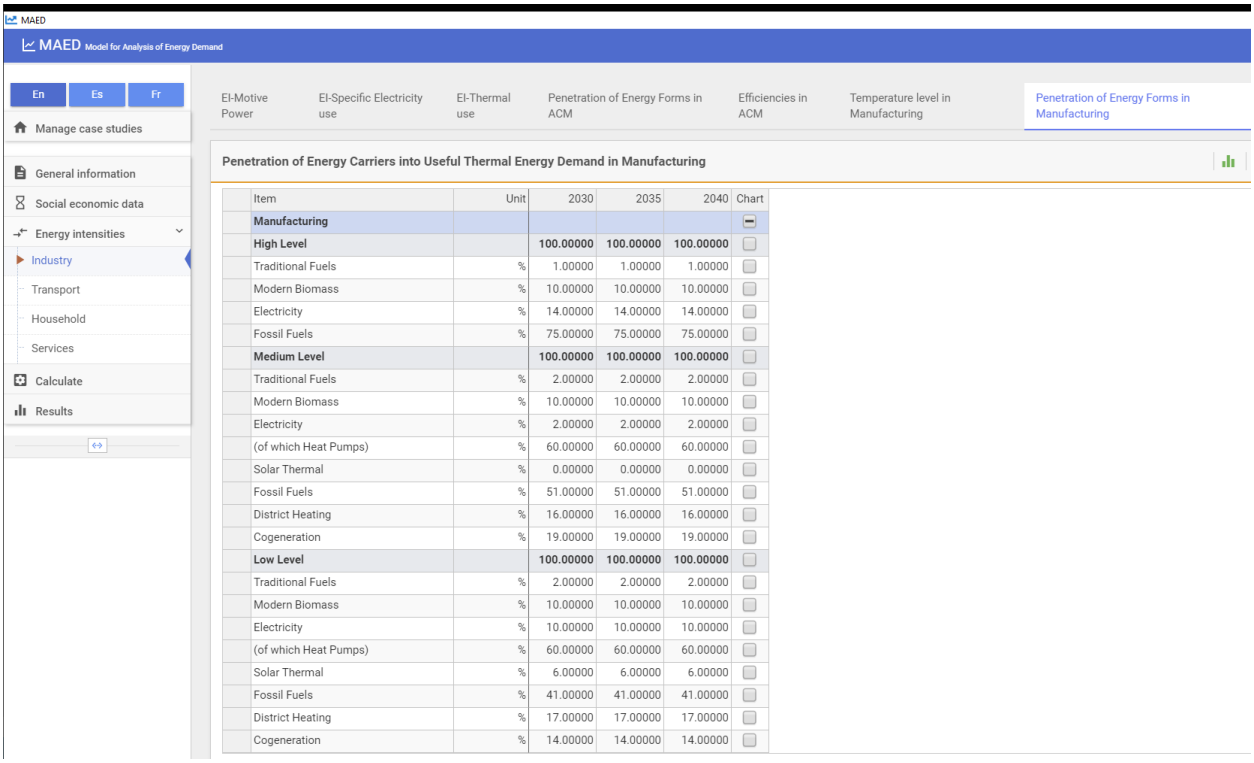
Finally you should be able to fill in the table on the **Specific Energy Consumption** as shown below:

	Specific Electricity Use (fraction)	Motive Power (fraction)	Low Temperature (fraction)	Medium Temperature (fraction)	High Temperature (fraction)	Thermal Total (fraction)	Share of Thermal Low Temp %	Share of Thermal Med Temp (%)	Share of Thermal High Temp (%)
Specific Energy Consumption (kWh/USD)	0	0	0.069543279	0.053370423	0.088950705	0.211864407	32.82442748	25.19083969	41.98473282

Then move to IND_MAN_Inp sheet to copy paste the data into MAED and update the data in the picture below to tell MAED about the Temperature level in Manufacturing.

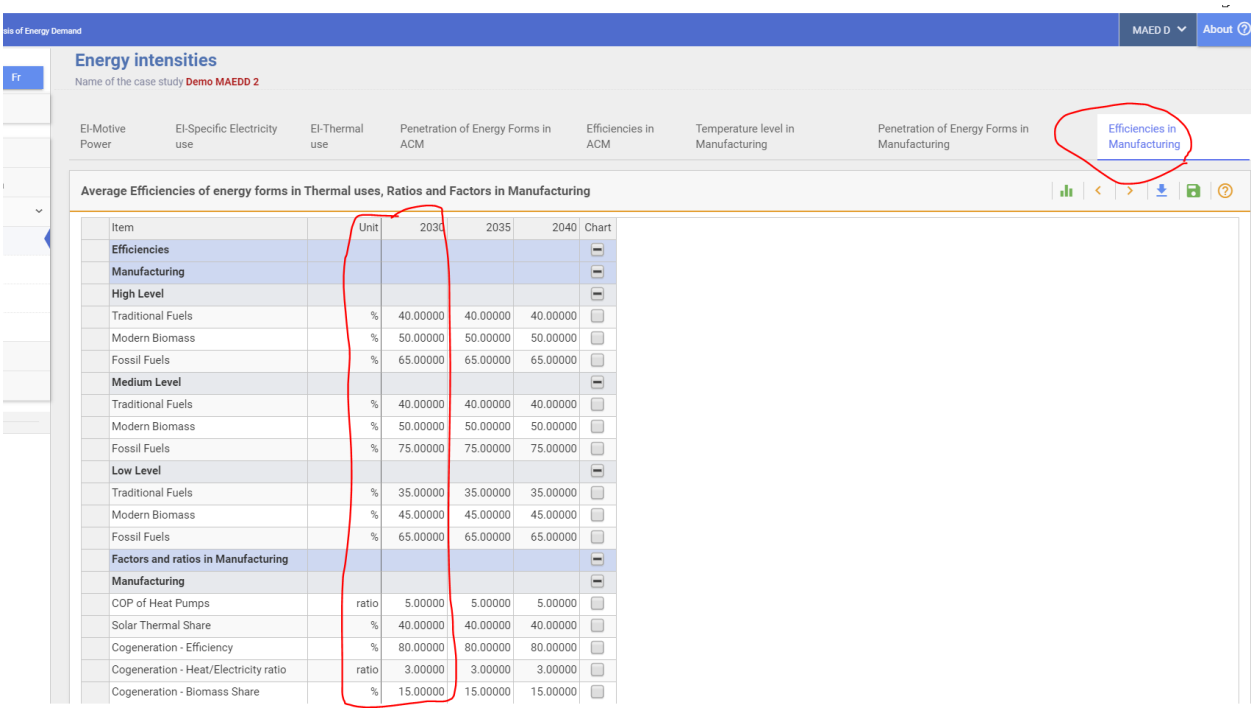


Then, you need to add the **Penetration of Energy Forms** in Manufacturing for 2030 and with your own data.



Item	Unit	2030	2035	2040	Chart
Manufacturing					
High Level		**100.00000**	**100.00000**	**100.00000**	
Traditional Fuels	%	1.00000	1.00000	1.00000	
Modern Biomass	%	10.00000	10.00000	10.00000	
Electricity	%	14.00000	14.00000	14.00000	
Fossil Fuels	%	75.00000	75.00000	75.00000	
Medium Level		**100.00000**	**100.00000**	**100.00000**	
Traditional Fuels	%	2.00000	2.00000	2.00000	
Modern Biomass	%	10.00000	10.00000	10.00000	
Electricity	%	2.00000	2.00000	2.00000	
(of which Heat Pumps)	%	60.00000	60.00000	60.00000	
Solar Thermal	%	0.00000	0.00000	0.00000	
Fossil Fuels	%	51.00000	51.00000	51.00000	
District Heating	%	16.00000	16.00000	16.00000	
Cogeneration	%	19.00000	19.00000	19.00000	
Low Level		**100.00000**	**100.00000**	**100.00000**	
Traditional Fuels	%	2.00000	2.00000	2.00000	
Modern Biomass	%	10.00000	10.00000	10.00000	
Electricity	%	10.00000	10.00000	10.00000	
(of which Heat Pumps)	%	60.00000	60.00000	60.00000	
Solar Thermal	%	6.00000	6.00000	6.00000	
Fossil Fuels	%	41.00000	41.00000	41.00000	
District Heating	%	17.00000	17.00000	17.00000	
Cogeneration	%	14.00000	14.00000	14.00000	

Finally, you will need to add data for the Efficiencies in Manufacturing as shown in the example.



Item	Unit	2030	2035	2040	Chart
Efficiencies					
Manufacturing					
High Level					
Traditional Fuels	%	40.00000	40.00000	40.00000	
Modern Biomass	%	50.00000	50.00000	50.00000	
Fossil Fuels	%	65.00000	65.00000	65.00000	
Medium Level					
Traditional Fuels	%	40.00000	40.00000	40.00000	
Modern Biomass	%	50.00000	50.00000	50.00000	
Fossil Fuels	%	75.00000	75.00000	75.00000	
Low Level					
Traditional Fuels	%	35.00000	35.00000	35.00000	
Modern Biomass	%	45.00000	45.00000	45.00000	
Fossil Fuels	%	65.00000	65.00000	65.00000	
Factors and ratios in Manufacturing					
Manufacturing					
COP of Heat Pumps	ratio	5.00000	5.00000	5.00000	
Solar Thermal Share	%	40.00000	40.00000	40.00000	
Cogeneration - Efficiency	%	80.00000	80.00000	80.00000	
Cogeneration - Heat/Electricity ratio	ratio	3.00000	3.00000	3.00000	
Cogeneration - Biomass Share	%	15.00000	15.00000	15.00000	

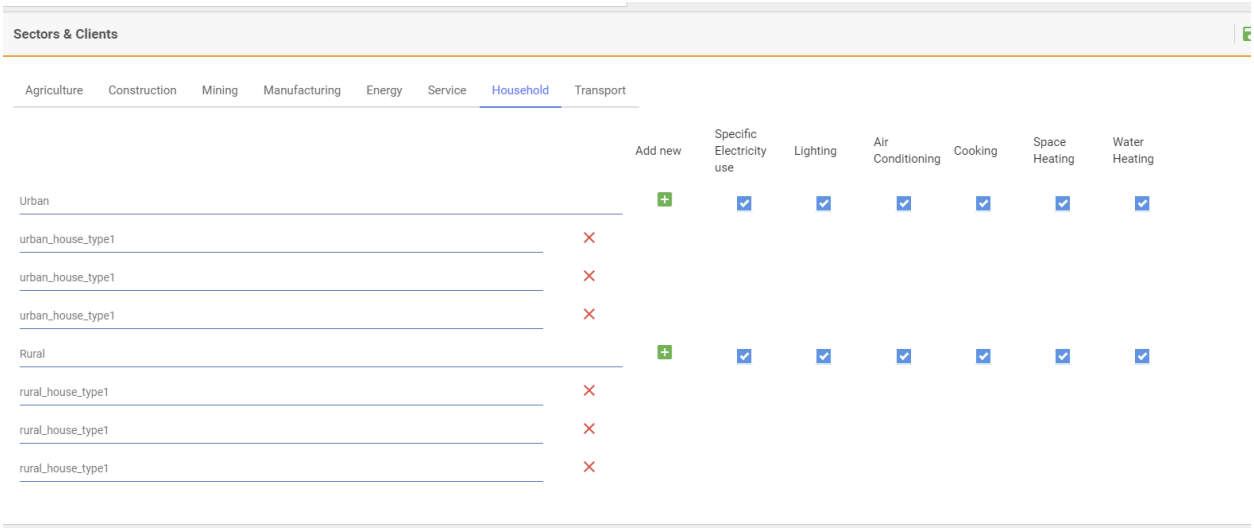
Then as done for the Agriculture sector, you will have to check that your MAED results are the same as the data in your Excel Template. Go to Results, then to 2.3.4. Total Final Energy Demand in Manufacturing (absolute) in 2030. If the results are the same, you have successfully reconstructed the Base Year for Manufacturing.

Activity 2: Specific requirements of the Household Sector

The first thing we need to do is to add the Socio-Economic Data for the Household sector for **Demography**. In particular, for the Demography data you will have to fill in all the white cells such as **Urban Population, Person/ urban Household, Person/ rural Household** etc, specific to your case study.

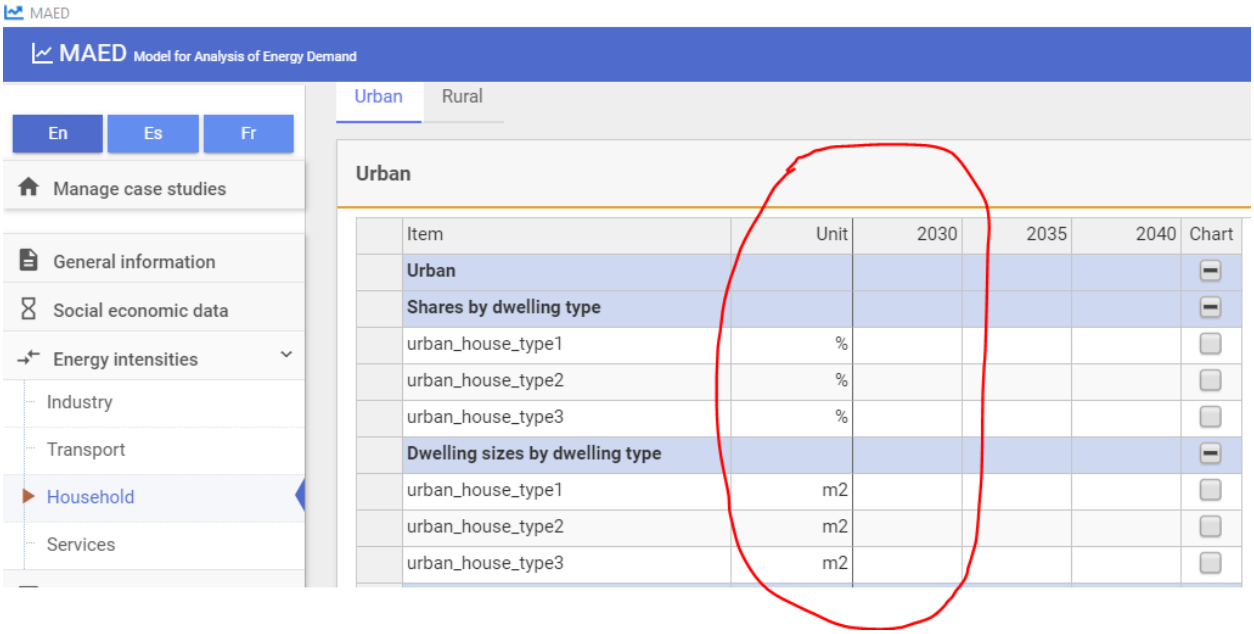
Then we move on to the **Energy Intensities data**.

The Household sector is divided into two subsectors: Urban and Rural. Then, we have six end-uses: Specific Electricity Use, Lightening, Air Conditioning, Cooking, Space Heating and Water Heating.

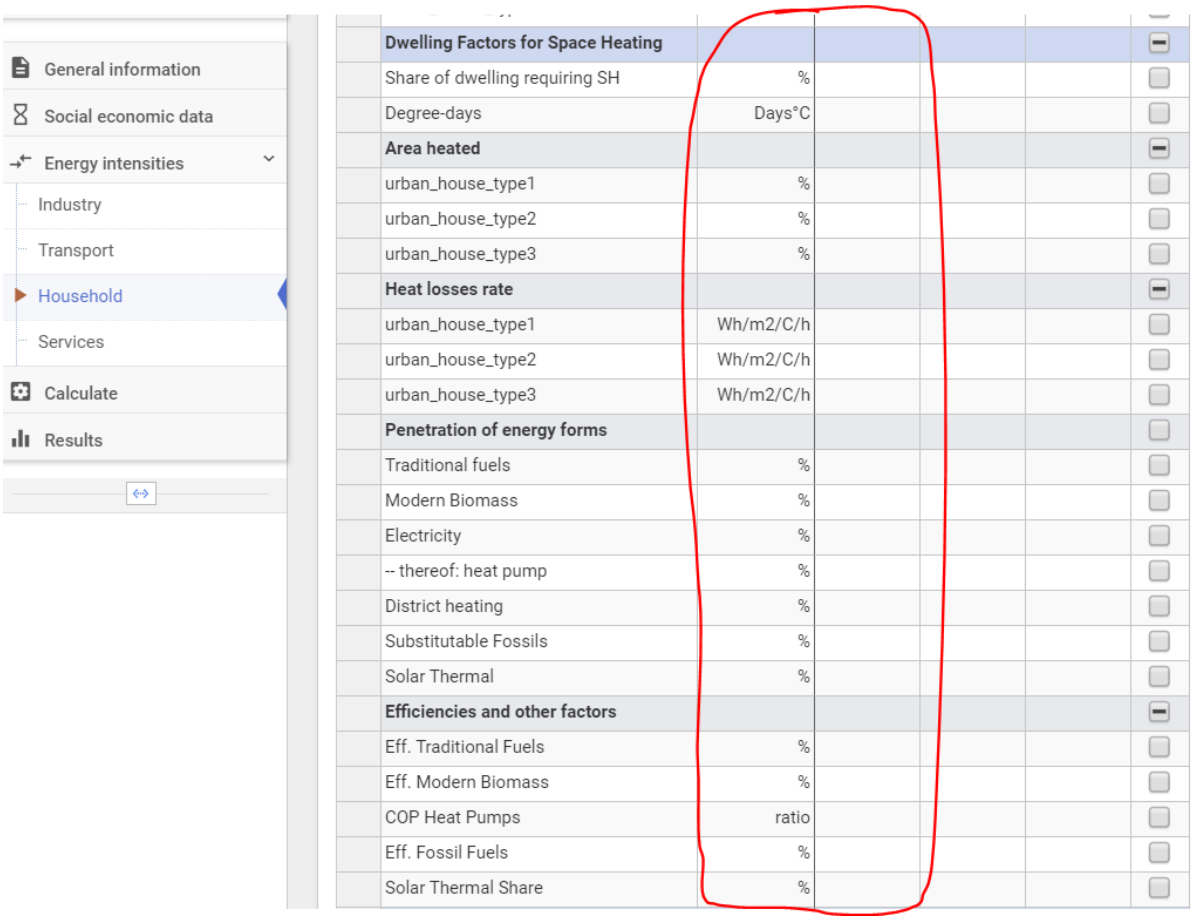


Please download the updated template with the structure needed to collect and reconstruct the Household sector Urban and Rural. As an example we will see the Urban, but the same applies to Rural.

The first data we'll have to collect are the **Shares by dwelling type**, so for example how many apartments (in percentage) there are compared to the total number of dwellings? Then we need to add the **Dwelling sizes by dwelling type** in m2, so how big is each type of dwelling?



Now we need to move on to collect and calculate the data required by each end use. Let's start from Space Heating. Firstly, we need to know the **Dwelling Factors for Space Heating**, so how many dwelling in percentage require Space Heating and the Degree Days. Then we move on to the **Area Heated in percentage** and the **Heat Losses Rate per each type of dwelling in Wh/m2/C/h**. Then, as done in the past we will have to calculate (using the Excel template as a support) the **Penetration of Energy Forms** which now are: Traditional fuels, Modern Biomass, , District heating, Substitutable Fossils, Solar Thermal and Electricity (of which a certain percentage will be used for Heat Pumps). Finally, we input data for Efficiencies and other factors for Traditional Fuels, Modern Biomass, Fossil Fuels, Solar Thermal Share and the Coefficient of Performance (COP) for the Heat Pumps.



Similarly we move on and input all the data for the other end uses of the Household Sector (Urban) such as Water Heating, Cooking, Air Conditioning, Appliances and Lightening.

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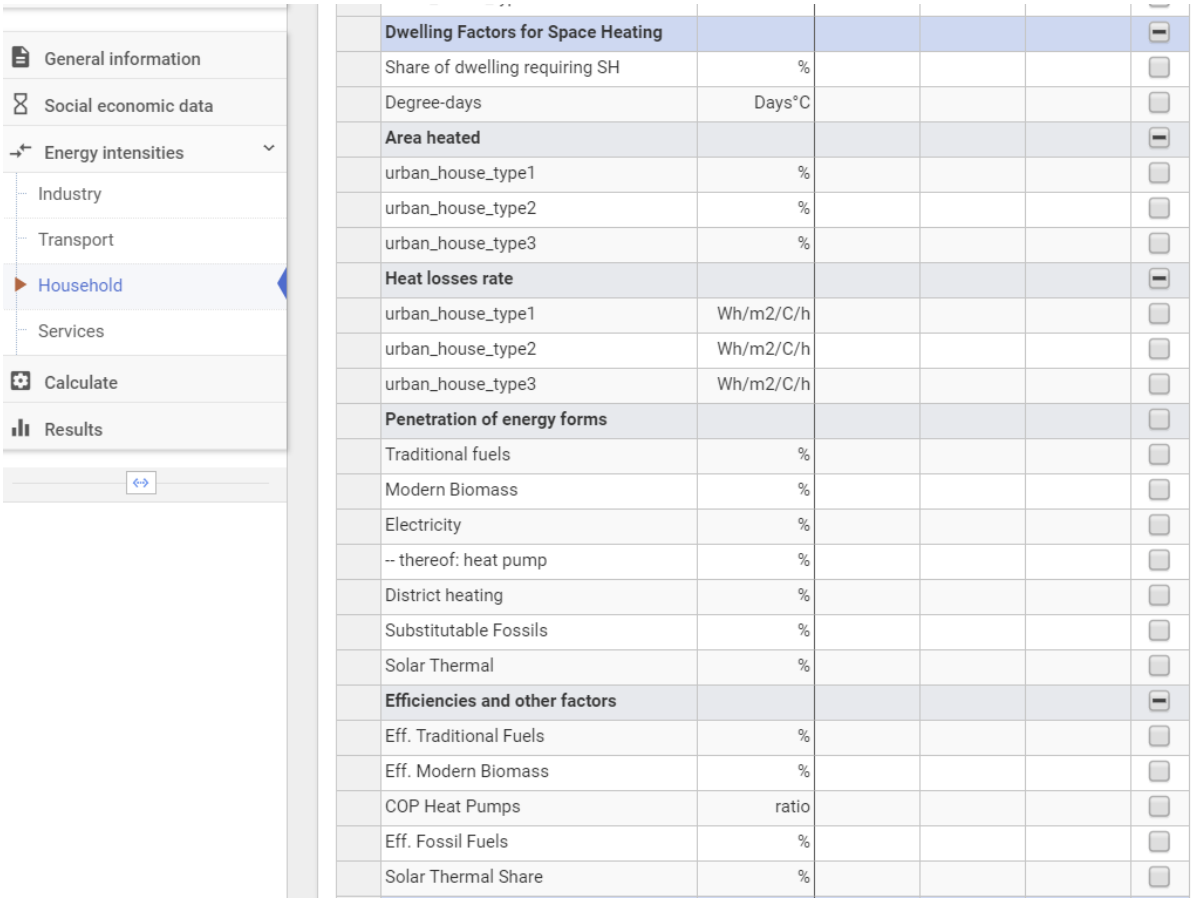

Dwelling Factors for Space Heating						
Share of dwelling requiring SH	%					
Degree-days	Days°C					
Area heated						
urban_house_type1	%					
urban_house_type2	%					
urban_house_type3	%					
Heat losses rate						
urban_house_type1	Wh/m2/C/h					
urban_house_type2	Wh/m2/C/h					
urban_house_type3	Wh/m2/C/h					
Penetration of energy forms						
Traditional fuels	%					
Modern Biomass	%					
Electricity	%					
-- thereof: heat pump	%					
District heating	%					
Substitutable Fossils	%					
Solar Thermal	%					
Efficiencies and other factors						
Eff. Traditional Fuels	%					
Eff. Modern Biomass	%					
COP Heat Pumps	ratio					
Eff. Fossil Fuels	%					
Solar Thermal Share	%					

Now repeat the same steps for the Rural Subsector, which is really like the Urban one.